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ABSTRACT

The integration of existing applications in hypermedia environments is a promising approach towards more flexible and user-friendly hypermedia learning materials. A hypermedia courseware editor, called HyDE (Hypermedia Document Editor) was developed using Microsoft Windows TM OLE technology. OLE (object Linking and Embedding) stands for an extensible protocol that enables one application to use the services of others applications. HyDE acts as an OLE client capable of receiving OLE data from several commercial OLE servers. The role of hypermedia documents in distance learning is twofold: a hypermedia document may contain a pre-prepared lesson which can be downloaded in students' workstations, and it may contain self-study material. HyDE provides for the possibility to attach lists of keywords to HyDE lessons, as well as to individual OLE files particularly suitable for constructing templates of multimedia objects; objects can be easily transferred from one document to another by the "cut, copy and paste" facilities of the MS Windows clipboard. Currently all OLE servers are single user applications. In general, hypermedia learning material appears useful because it allows fast preparation of courseware that is flexible for modification. (AEF)

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Integrating Existing Applications in Hypermedia Learning Material (General Issues & Experiences with OLE Technology)

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Abstract: Integration of existing applications in hypermedia environments is a promising approach towards more flexible and user-friendly hypermedia learning material. In this paper we describe some issues, methods, and observations related to the design of a hypermedia courseware editor that is capable of integrating existing applications.

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The aim of distance education environments is to provide learning resources to large numbers of students spread over wide geographical areas. The social significance of these systems is twofold. On one hand, they are helpful to bridge the gap between isolated students and learning centers. On the other hand, they allow teachers to be efficiently 'shared' over several geographically distributed students. Traditionally, learning material in distance learning environments consist of rather static material like printed text, audiocassettes and videocassettes. Computer supported courseware based on hypermedia technology opens new perspectives for distance education. Hypermedia learning material can be developed in less time, is more flexible for modifications than traditional learning material and can be distributed relatively fast over computer networks. Integration of existing applications in hypermedia environments (Nielsen, 1990) is a promising approach towards more flexible and user-friendly hypermedia learning material.

Objectives of the design of a hypermedia courseware editor

Our first objective was to design a hypermedia courseware editor that is capable of integrating existing applications. From the engineering point of view the advantage is obviously. We follow the object oriented approach which basically promotes efficiency by re-using existing software. From the end user's point of view we can mention the advantage that integrating existing applications in a hypermedia environment allows students and teachers to use their familiar set of applications in order to create or edit multimedia objects. As a consequence users will need less time in learning to work with the new environment.

A second objective consisted in obtaining a modeless editor which supports both authoring and reading of hypermedia documents based on one underlying metaphor. With this objective in mind we want to avoid the traditional gap that exists between on one hand a relatively small group of "expert" hypermedia authors and on the other hand a large group of hypermedia consumers.

Methods of the design of a hypermedia courseware editor

OLE technology

We developed a hypermedia courseware editor called HyDE (**Hy**permedia **D**ocument **E**ditor) (Borst Pauwels, Pinto, Sousa Santos, & Martins, 1993). We integrated existing applications by using Microsoft ® Windows TM OLE technology. OLE, Object Linking and Embedding, stands for an extensible protocol that

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enables an application to use the services of other applications. Basically, this implies that a user does not have to leave an application (OLE client) in order to create or edit application specific data, but instead more comfortably, simply launch an application (OLE server) by a mouse click on the specific data.

Electronic Overhead Projector

HyDE acts as an OLE client capable of receiving OLE data from several commercial OLE servers. An overhead projector was used as the underlying metaphor. Our editor act as an "electronic" overhead projector on which lessons composed of piles of "electronic" transparencies, can be displayed either in simple sequential order or in more sophisticated so-called "web" structures. More precisely, in our approach, one hypermedia node consists of a background transparency which may, or may not, be covered by one or more overlaying transparencies.

Background transparencies can be filled with OLE objects and afterwards connected by means of anchors, either to other background transparencies or to overlaying transparencies (Figure 1).

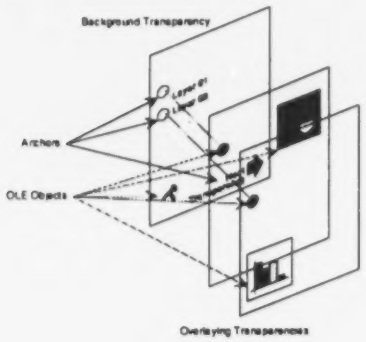

Figure 1. Transparency organization

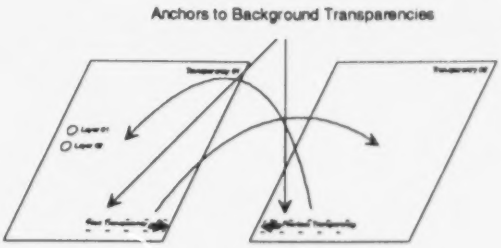

Figure 2. Anchors connected to background transparencies

An anchor is an rectangular area on a background transparency. When it is introduced a new blank background transparency will be automatically displayed or, in case the user requested a connection to an overlaying transparency, a new blank overlaying transparency will be automatically inserted over the background transparency. In both cases, the new blank transparency can be filled with OLE objects. A mouse click on an anchor connected to a background transparency will trigger an event that displays again the associated background transparency (Figure 2).

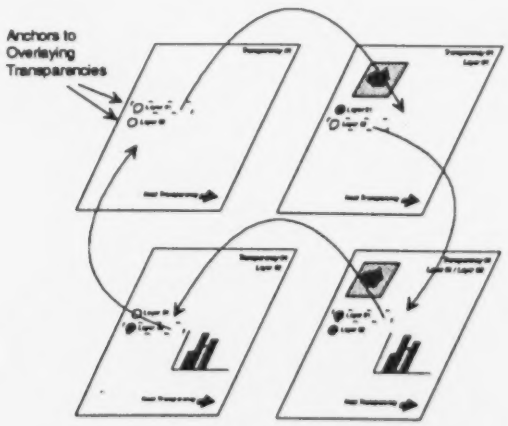

Figure 3. Anchors connected to overlaying transparencies

A mouse click on an anchor connected to an overlaying transparency will trigger an event that inserts the associated overlaying transparency over the background transparency or, in case the overlaying transparency is already inserted, removes it (Figure 3).

For a more detailed description of the functionality of HyDE see (Pinto, Borst Pauwels, Sousa Santos & Martins, 1994).

General issues related to hypermedia learning material

Hypermedia stands for a specific kind of information system in which information is stored in graph- or web- structures. The basic unit of such information systems is a node which can be linked to other nodes by mean of links. This non-linear aspect of storing information is fundamental for both hypertext and hypermedia. They allow users to read or traverse documents in a non-linear fashion. In this section we indicate some issues related to hypermedia learning material in distance education environments.

Document

The role of hypermedia documents in distance learning environments is twofold. Firstly, a hypermedia document may contain a course which can be downloaded on the student's workstations. Subsequently, the teacher gives a remote lecture by presenting the pre-prepared lesson to the audience of students. Its is important that in such "tele-teaching " situation the hypermedia structure is not meant to be explored but to be presented. Second, a hypermedia document may contain self study material. This implies that the readers, i.e. the students, are confronted with a priory unknown information. This information is then not meant to be presented as in a tele-teaching situation but typically to be explored. In this context self study learning material adheres more closely to the real essence of hypermedia structures i.e. browsing of knowledge.

Bearing in mind the two user tasks, presentation and exploration, we are left with the question how learning material should be structured into networks of nodes. Kahn (1989) indicates how hypermedia systems eventually affects the meaning that is stored in hypermedia documents. The author reviews that in hypermedia systems like KMS and Hypercard, nodes are mapped as single screens or windows which are linked with uni-directional links from an object in one screen to another screen. The start of a link may have a fine granularity but the granularity of the destination of links is coarse. Systems like Guide and Intermedia provide a much finer granularity for the destination of a link, nodes are not restricted to a fixed screen but can consist out of multiple windows with flexible size.

In case of remote presentation of a lesson fine granularity of destination links is not strictly a necessity due to the fact that the teacher can use a telepointer to point to specific regions in a destination node. In self study learning material however, fine granularity of the destination of links might be preferable because of the lack of a teacher pointing to specific regions in a node.

Archive

In distance learning environments it is vital to store learning material in a central storage. Central storage, like databases installed on servers, provide the huge storage capacity needed to contain complete libraries of pre-prepared and/or un-prepared learning material. We distinguish here explicitly between pre-prepared and un-prepared or background learning material. Pre-prepared learning material are hypermedia documents which contain lessons for either tele-teaching or self study. Background learning material is the bulk of information which teachers can refer to in order to place lessons in a broader context. This background material will be pre-dominantly non-hypermedia material. For instance, a lesson about famous composers could refer to parts of the complete work of Beethoven.

Learning material should be stored in an information system or archive that allows effective searching strategies. This archive can be implemented either as a file system, a traditional database, or a hypermedia network. Eventually the choice for a specific information system will determine which searching strategies are possible. File systems enable users to perform only a primitive form of information retrieval which basically consist of traversing file names stored in a file tree. Traditional databases allow analytical search strategies,

like Boolean keyword oriented procedures or query languages. Information systems build as networks of nodes containing the learning material allow users to retrieve information by browsing. In (Marchionini & Shneiderman, 1988) the authors review some aspects of information retrieval in hypertext systems. They conclude that browsing of knowledge, which is inherent to hypermedia, gives good performance in case of exploring new-task domains, but performance is rather low in case of fact retrieval. The authors point out that determining criteria for optimal mixes of browse and analytical support is critical to development.

We assume most students will enter a new-task domain when consulting learning material and benefit if the environment supports analytical searching strategies. However, experienced students and teachers will mostly explore familiar knowledge and will be best served by the hypermedia browsing capacities of an information system.

Preparation

The inertia of learning material may be identified as one of the drawbacks in traditional distance learning. New generation distance learning environments should not only provide the means for creating flexible or customizable learning material but above all they should lower the threshold for authoring. Semi structured nodes (Conklin, 1987), which are nodes that already contain pre-prepared templates may be particularly helpful towards generic or customizable learning material.

Specifically for preparing lessons, there is a need for multimedia object libraries. They are typically pre-prepared hypermedia documents containing various assortments of objects. For instance, an object collection may contain a large set of, hypermedia organized, sound samples of ancient instruments or contain a large set of digitized photos of various tropical birds. Object libraries differ from above mentioned background information in that they are not meant to refer to, but merely they are "cut and paste" material for hypermedia document preparation.

Annotation

It is vital in learning processes that students can comment their learning material. Therefore a hypermedia system should allow students to create new nodes and links in any instance. This would imply a modeless hypermedia editor which supports simultaneously browsing and the possibility to add new nodes and links.

Sharing

Inherent to groupware (Ellis, Gibbs, & Rein, 1991) are a "shared environment" and a "common task". In distance learning we may distinguish different common tasks and different shared environments. Basically all learning resources can be shared, that means both social learning resources, like teachers, and learning material can be shared among participants. Sharing learning material can take place on two levels. Sharing the central archive and sharing of hypermedia documents. Sharing the archive is less a groupware issue but more a time-sharing problem. Associated with it is the design of mechanisms for user identification and the possibility to assign read and write access to documents.

Co-authoring of learning material is a real groupware issue in that sense that it combines both the notion of a shared environment and a common task. The shared environment is a hypermedia document, or better, the public window of a hypermedia editor which instances appear on several workstations. The common task is preparation of a hypermedia document. In groupware taxonomy, co-authoring of hypermedia documents can be classified under multi-user editors.

Using OLE technology for Hypermedia: Some observations

Using OLE technology for hypermedia environment implies that we are somehow steered in our design decisions. We describe some experiences we had with OLE technology and place it in the context of the issues we mentioned previously.

Document

The impact that OLE technology has on the structure of an hypermedia document is visible in both nodes and links. An essential aspect of OLE technology is that we (the OLE client) can control the representation of an OLE objects but not the behavior, which is controlled and defined by an OLE server. This will affect the granularity of the destinations of hypermedia links. Our hypermedia editor is capable of making links with fine-granular destinations in so far it is within the graphical representation of an OLE object. In case of dynamic objects, like sounds or animation's, the destinations of links are limited only to the graphical representations of these objects. For example, we can point to the graphical representation of a sound or animated object but not to a specific location within such dynamic object.

Using OLE object excludes the "hypermedia node to one window mapping" approach in case we open (or play) an OLE object because it's associated OLE server will pop up in a separate window. Figure 4, shows an example of a typical HyDE transparency. Figure 4, at the left shows a background transparency with a combination of OLE text, OLE drawing, OLE image in combination with an superimposed overlaying transparency containing a "pie chart". The underlined words in the text, the button "Previous Page" and the question marks in the image are representations of anchors connected to background transparencies. Whereas the buttons, "Show Bars Graph" and "Show Pie Chart" are representations of anchors connected to overlaying transparencies. Figure 4, at the right shows how the OLE object, after a mouse click, is opened by its associated OLE server in a separate window.

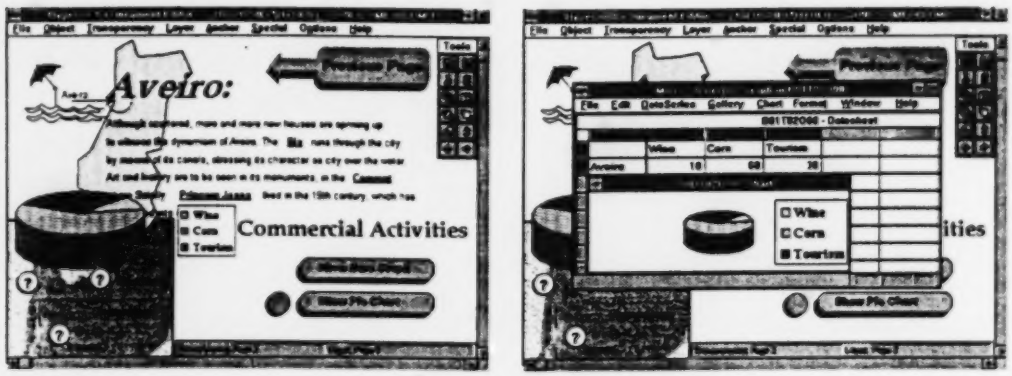

Figure 4. HyDE transparencies

Archive

HyDE documents can be stored in several databases. The structures of OLE objects are transparent for the database. Therefore, in order to allow effective search strategies, it is preferable to attach additional information to each OLE file. In HyDE, we provide the possibility to attach lists of keywords to HyDE lessons as well to individual OLE files before storing them on the server. These keywords typically describe the contents of lessons and OLE files and allow students and teachers to search for information with Boolean and keyword based procedures.

Preparation

OLE technology seems particularly suitable for constructing templates of multimedia objects. For example, a teacher can incorporate some blank spreadsheet cells made by a specific OLE server. Students can subsequently trigger the spreadsheet application by a mouse click and fill the blank cells.

With OLE, objects can be easily transferred from one document to another by the "cut, copy and paste" facilities of the MS Windows clipboard. This feature specifically will encourage the creation and use of multimedia object libraries.

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Annotation

The ability for students to make annotations is not specifically influenced by using OLE technology. It is imbedded in the capabilities of the hypermedia editor to create new nodes and links while a reader is browsing the document.

Sharing

Currently all OLE servers are (to the best of our knowledge) single user applications. This implies that co-authoring in OLE based hypermedia editors is restricted to the level of composing hypermedia pages in the form of cooperative re-arranging of the graphical presentations of OLE objects.

Due to the fact that the format OLE objects are transparent for the archive, write and read administration can only take place on object level. This restrict us in the abilities, to differentiate between parts of an OLE object with or without write protection.

Discussion

We indicated several issues related to hypermedia learning material in distance learning environments and described the impact that OLE technology might have on each of these issues.

Both the advantages and limitations of OLE technology seem to be imbedded in its format or object independent approach. With OLE we can build open hypermedia environments which can benefit of, and anticipate on, a still growing spectrum of OLE editors. The price we pay for this object independence is that the structure and behavior of objects are transparent for the hypermedia environment. This will result in a lost in flexibility to create concurrent and synchronized behavior of OLE objects and a lost in flexibility in creating fine-granulated destinations of hypermedia links in case of dynamic objects. However, related to hypermedia learning material OLE technology appears useful because it allows fast preparation of courseware that is flexible for modification.

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